# LUMBER? or CHIPS?

## A Comparison of Small-Log Utilization Alternatives

by
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& Robert Bain

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## The Authors:

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ROBERT BAIN *was graduated from the University of Pittsburgh with a Bachelor's degree in business management. He has been employed by the Forest Service since 1935; his first assignments were on the administrative staffs of national forests — the Jefferson, the Green Mountain, and the George Washington. Following that he was Region 7 Auditor as well as Regional Accountant. In 1950 he joined the Northeastern Station, where he now heads the Division of Station Management. He served in the Navy during World War II.*

# The Problem

A SAWMILL in the Northeast commonly receives a number of small low-quality logs. They may be among logs purchased from independent loggers, or timber-sale specifications may require that the sawmill take them. Some mill operators confronted with logs of this kind consider handling them as part of the cost of obtaining their log supply. Others may feel that, since the logs are at the mill and paid for, they should be sawed for whatever lumber they will produce.

Since use of chippers has become widespread in the Northeast it is probably not surprising that a number of sawmill operators have been asking questions related to the utilization of small low-quality logs. Should these small logs be chipped? or sawed into lumber? If so, where should the line be drawn between those that should be sawed and those that should be chipped?

In an attempt to answer some of these questions, small-log utilization was studied at a Northeastern sawmill. A comparison was made between the profitability of sawing small logs into

lumber, or chipping the whole log. Even though costs differ between mills, and lumber and chip prices vary, it was felt that a study at one mill would answer some of the questions that have been asked. This paper describes our study and the results obtained.

## The Study Mill

The sawmill that participated in our study produces 10,000 to 20,000 board-feet of lumber per day. Located in western Maine, it produces mainly eastern white pine lumber. The mill operator obtains some of his log supply from independent loggers and some from stumpage sales. In the latter case, the mill operator contracts the felling, bucking, and skidding to independent loggers. He does the loading and hauling himself.

There is a wide range in the sizes and quality of the logs delivered to the mill, and in keeping with the close utilization practiced in the Northeast many of the logs are small and of low quality. Material is cut that will produce a log at least 6 inches in diameter and 8 feet long. Many of the logs are crooked and knotty. Therefore a number of logs was available for which the chipping alternative might seem preferable.

The mill was equipped with a log debarker, and all logs were debarked before sawing. Twin circular headsaws were used for sawing; the carriage was the log-beam type. Slabs, edgings, and trimmings were chipped and loaded into trailers for shipment to a nearby pulp mill.

As at most sawmills of the type described here, the chipper operates considerably below capacity. Therefore, if it were desirable to chip some logs, this could be done easily with the existing facilities. But the limited throat capacity of the chipper (4 x 12 inches) would necessitate slabbing the logs with the headsaw.

## Method of Analysis

To compare the chipping and lumber-production alternatives, a form of break-even chart was used. The difference between the usual applications of the break-even chart and its use here is that

some costs were excluded from our analysis. We did not include overhead costs and the cost of logs and debarking. Overhead costs would be the same for either chipping a log or sawing it into lumber. In addition, once a log has been purchased and debarked, these outlays might as well be treated as overhead, and the difference between subsequent direct costs and log product revenues should be maximized. This difference, or margin, was estimated in our analysis.

Note that margins determined by the method described above are not to be interpreted as profit margins. Neither can they be used to determine whether or not a log should have been purchased. What they do indicate is the contribution each production alternative makes to the margin for log and debarking costs, overhead, and mill profit. If a mill operator must process a log that has been delivered to the mill and debarked, he is interested in the production alternative that makes a larger contribution to this margin.

# Estimating the Margin For Lumber Production

## Product Revenues

When a log is sawed into lumber, three products result: lumber, sawdust, and chippable residues (slabs, edgings, and trimmings). Therefore, to determine total log product revenue for lumber production, it was necessary to obtain estimates of the average volume and value of each of these products. These estimates were determined for each log size and log-grade class included in the study. They were obtained from a sample of 226 logs taken at the mill.

When each log in the sample reached the mill deck, it was graded[1] and its length and end diameters were measured. Logs

[1] Logs were graded according to white pine log-grade specifications developed at the Northeastern Forest Experiment Station.

larger than 11 inches scaling diameter and Grade 1 logs were excluded from the sample. Clearly, it would be undesirable to consider chipping these logs.

The lumber produced from sawing each log was graded and tallied as the log was sawed. The tally included the dimensions and board-foot content of each board. The cubic volume of sawdust that resulted from sawing each log was calculated by using average saw kerf, log length, end diameters, and number and

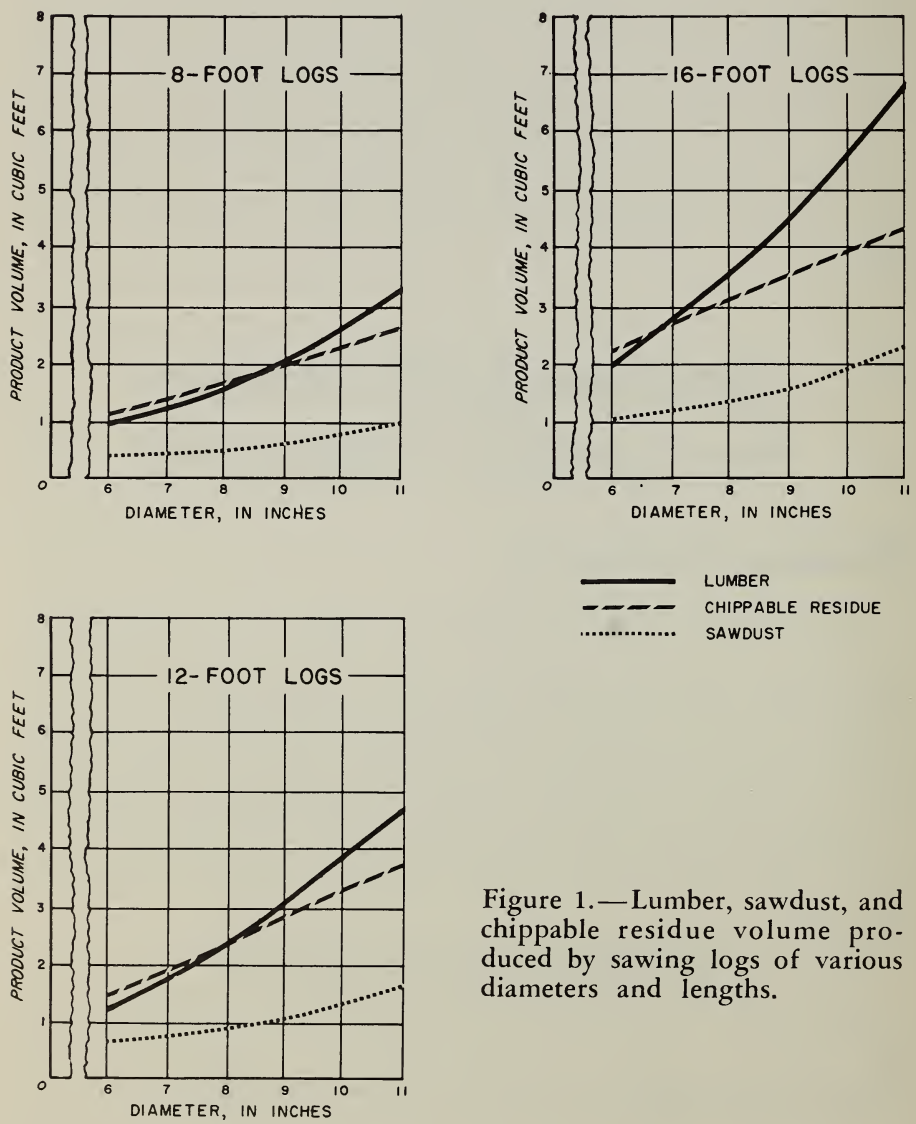


Figure 1.—Lumber, sawdust, and chippable residue volume produced by sawing logs of various diameters and lengths.

Table 1.--*Lumber recovery and green lumber value of white pine logs, by log size and grade*

| Log diameter (inches) | Log scale | Lumber tally by log grade-- | | | Lumber value by log grade-- | | |
|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 2 | 3 | 4 |
| | *Board -feet** | *Board-feet* | | | *Dollars* | | |
| | | 8-FOOT LOGS | | | | | |
| 6 | 10 | -- | 8 | 9 | -- | 0.64 | 0.61 |
| 7 | 10 | 13 | 10 | 10 | 1.34 | .80 | .68 |
| 8 | 15 | 16 | 15 | 15 | 1.65 | 1.20 | 1.02 |
| 9 | 20 | 19 | 20 | 20 | 1.95 | 1.60 | 1.36 |
| 10 | 30 | 22 | 26 | 25 | 2.26 | 2.08 | 1.70 |
| 11 | 35 | 27 | 30 | 32 | 2.78 | 2.40 | 2.18 |
| | | 12-FOOT LOGS | | | | | |
| 6 | 15 | -- | 14 | 15 | -- | 1.12 | 1.02 |
| 7 | 20 | 23 | 20 | 19 | 2.36 | 1.60 | 1.29 |
| 8 | 25 | 27 | 26 | 25 | 2.78 | 2.08 | 1.70 |
| 9 | 35 | 35 | 35 | 35 | 3.60 | 2.80 | 2.38 |
| 10 | 45 | 45 | 43 | 45 | 4.63 | 3.44 | 3.06 |
| 11 | 55 | 54 | 52 | 53 | 5.56 | 4.16 | 3.60 |
| | | 16-FOOT LOGS | | | | | |
| 6 | 20 | -- | 25 | 18 | -- | 2.00 | 1.22 |
| 7 | 30 | 34 | 30 | 26 | 3.50 | 2.40 | 1.77 |
| 8 | 40 | 39 | 40 | 38 | 4.02 | 3.20 | 2.58 |
| 9 | 50 | 48 | 50 | 50 | 4.94 | 4.00 | 3.40 |
| 10 | 65 | 60 | 65 | 65 | 6.17 | 5.20 | 4.42 |
| 11 | 80 | 70 | 77 | 80 | 7.20 | 6.16 | 5.44 |

*International $\frac{1}{4}$-inch rule.

widths of saw cuts. Chippable residue volume was then determined by subtracting lumber and sawdust volume from total log volume.

The curves shown in Figure 1 were graphically fitted to plotted recovery data for each of the three mill products. Though cubic lumber volume was used only in determining chipped residue volume, it has been included in the graph to show the relationship between log size and the distribution of mill products.

The average board-foot recovery and the value of the lumber produced from logs of various sizes and grades are shown in Table 1. To calculate these lumber values, prices for rough green lumber were used. At the time the study was made, these lumber prices were:

| *Grade* | *Price per M.b.m.* |
|---|---|
| D Select and better | $180 |
| 1 & 2 Common | 125 |
| 3 Common | 95 |
| 4 Common | 65 |
| 5 Common | 45 |

The average gross value of chippable residues that resulted from sawing various sizes of logs into lumber was obtained by multiplying the price of chips by the chippable residue volumes indicated in Figure 1. Chip price was $8.50 per ton f.o.b. sawmill. This is equivalent to $0.172 per cubic foot if a conversion factor of 40.4 pounds per cubic foot of solid chippable material is used.[2] A moisture content of 100 percent was assumed because the logs were stored in a pond.

Sawdust values were negligible for the sizes of the logs considered, so they were not included in the determination of the lumber-production margin.

## Direct Costs

A time study was conducted on the logs in our sample to determine how sawing time was affected by log diameter, log length, and log grade. Both log diameter and log length were found to be related to sawing time, but no apparent effects were associated with log grade. Sawing time was measured as the time that elapsed between loading a log on the carriage and the return of the carriage for the next log. Delay times not associated with any one log were distributed among all logs. Results of the time study are presented in Figure 2.

[2] Hamlin, M. E. Experience report — wastewood and chip volume measurement. Amer. Pulpwood Assoc. Northeast. Tech Comm. Minutes (1956): 14-16. 1956.

The direct-cost rate for sawing lumber was estimated to be $0.44 per minute. This estimate was based on expenditures for sawmill labor, power, maintenance, and supplies. Sawing time multiplied by this cost rate determined the direct sawing cost for each log size. These costs are also indicated in Figure 2 in the vertical (cost) axis on the right side of the graph.

The direct-cost rate for chipping residuals was estimated to be $0.74 per ton, or $0.018 per cubic foot. Included in the determination of this rate are the costs of labor, power, maintenance, and supplies used in operating the chipper.

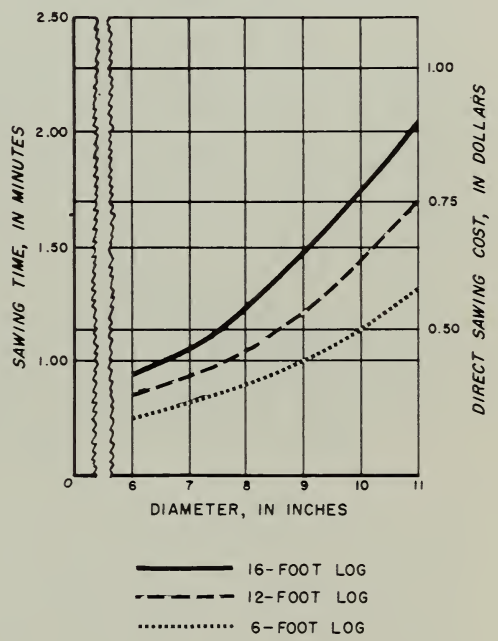


Figure 2.—Effect of log diameter and log length on sawing time and variable sawing costs.

To complete the calculation of the lumber-production margin, lumber and chipped residue value for each log size and grade were added together and the corresponding direct costs were deducted. The results of this calculation for each of the grades considered are shown in Figure 3. The curve for Grade 2 logs does not extend to 6 inches because 7 inches is the minimum diameter for this grade. As would be expected, the margins increase with log size and are higher for better-grade logs.

Table 2 was prepared to show the contribution that chipped residues made to the lumber-production margins. If debarking costs were deducted from the values included in Table 2, the remainder would be a reasonable estimate of the net profits obtained from chipped residues. While this calculation was not made, two offsetting factors would make the appropriate debarking cost deduction relatively small. First, part of the debarking cost should be charged to other stages of production. For example,

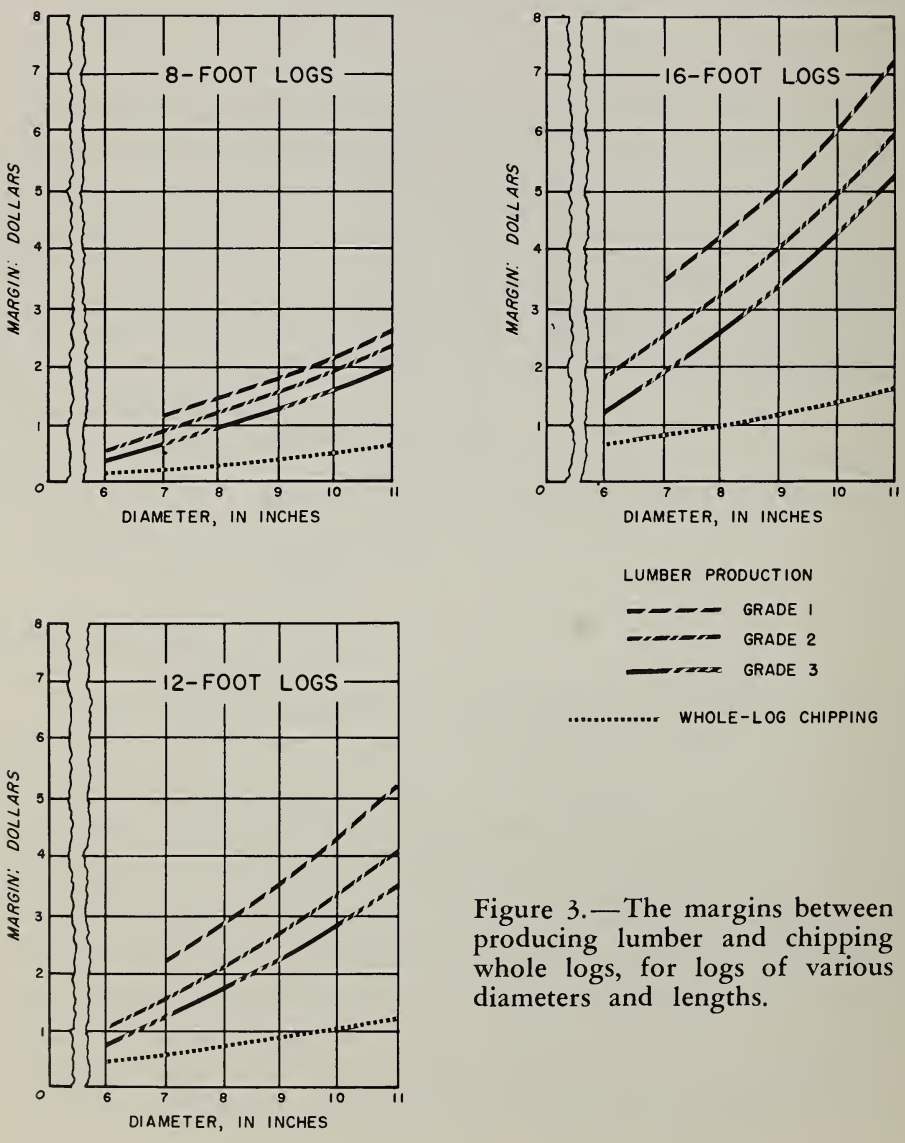


Figure 3.—The margins between producing lumber and chipping whole logs, for logs of various diameters and lengths.

Table 2.--*Contribution of chippable residues to lumber-production margin*

| Log diameter (inches) | Log length | | |
|---|---|---|---|
| | 8 feet | 12 feet | 16 feet |
| 6 | $0.16 | $0.23 | $0.35 |
| 7 | .20 | .30 | .43 |
| 8 | .23 | .36 | .52 |
| 9 | .27 | .44 | .61 |
| 10 | .33 | .52 | .70 |
| 11 | .39 | .62 | .81 |

saw-maintenance costs are reduced when logs are debarked. In addition, lumber volume, grade recovery, and mill productivity may be favorably affected by debarking. Finally, operating a debarker so that mill residues can be sold eliminates the cost of disposing of slabs and edgings.

# Estimating the Margin For Chipping Entire Logs

The gross value of the chips obtained from chipping a log was determined by multiplying chip price ($0.172 per cubic foot) by log volume. The direct cost for chipping logs was $0.018 per cubic foot, the direct cost used for chipping residuals, plus an additional charge for slabbing logs on the headsaw. Slabbing charges varied slightly with log size. The resultant direct cost was deducted from gross chip value to obtain the whole-log chip margin. The results of this calculation for various sized logs are presented in Figure 3.

A comparison between the lumber production and whole-log chipping alternatives can be made in Figure 3. At no point, it will be noted, does the chipping alternative contribute more to the margin from which log and debarking costs, overhead, and mill profit are taken than the lumber production alternative. To be sure, the margins are close for small diameter, 8-foot, Grade 4

logs; and since the curves are averages it is possible that a few of these logs might have contributed more to the margin if they had been chipped. Generally speaking, however, the results indicate that if small low-quality logs must be processed at the sawmill studied, a greater contribution will result from sawing them into lumber and chipping the residues.

# Conclusions

It would be misleading to conclude from our results that it would have been profitable for the mill participating in our study to saw small low-quality logs. Our analysis was conducted to provide some insight into what should be done with these logs if they were delivered to the mill, not whether delivery should have been made. Obviously, sawmill facilities are not meant to produce chips from whole logs. If logs or roundwood are to be chipped, this is a decision that should be made on the logging operation rather than at the sawmill.

Two further conclusions that are relevant to the operation of a sawmill can also be drawn from our study. For one thing, the fact that a mill operator has a chipper and is able to sell mill residues should not encourage him to slab logs heavily. If he has markets, this same material contributes considerably more to the margin from which profits are taken if it is converted into lumber rather than chips. Finally, the differences between the lumber production curves for the three log grades (Fig. 3) give some indication of the benefits from sawing higher grade logs. Since the grade of many logs is determined at the time they are bucked in the woods, careful supervision of this operation is especially desirable.


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